EFFECTS OF PHYTOGENIC FEED ADDITIVES CONTAINING *QUILLAJA SAPONARIA* ON AMMONIA IN FATTENING PIGS

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SUMMARY

The objectives of the presented studies were to investigate the effects of two phytogenic feed additive (PFA) containing extracts of *Quillaja saponaria* and essential oils as active ingredients on aerial ammonia (NH_3) and odor concentrations in growing-finishing pig houses.

Both trials were conducted in climatic chambers where temperature and ventilation were at the same level. With both products, Aromex ME Plus (AME+) and Fresta® F Plus (FF+) the ammonia emissions were reduced by 38% and 32%, respectively. The odor units were reduced by 34% with AME+ and 29% with FF+.

INTRODUCTION

Structural changes in agriculture towards fewer farms with higher numbers of animals per farm are causing problems due to ammonia but especially odor emissions. Approval processes for new buildings are often delayed due to conflicts between farmers and neighbors. Most EU countries have admitted to reduce their ammonia emissions. Thus, extensive research is done to identify solutions for ammonia abatement. Feed additives including saponins have been reported to reduce ammonia emissions (Colina et al., 2001; Veit et al., 2010). This effect might be explained by the direct binding of ammonia to saponins (Killeen et al., 1998) and/or the inhibition of the bacterial enzyme urease (Nazeer et al., 2002; Yeo and Kim, 1997), which catalyzes the hydrolysis of urea into ammonia and carbon dioxide. In comparing techniques like air cleaners or slurry spreading, Phytogenic feed additives can reduce the ammonia production/concentration already at animal level, which is increasing animal health and welfare. Calculations on economics for ammonia reducing techniques reveal that feed additives which increase performance can result in profits instead of costs per unit of ammonia.

MATERIAL AND METHODS

In both trials a total of 32 three-way hybrids, (Large White x Landrace) x Pietrain, were distributed to two treatment groups by weight and sex. Pigs were housed in two identical barns with two pens each with fully slatted floors for 8 fattening pigs from 30 to 110 kg live weight. Both groups received a basal diet during a 10 day adaption phase. Water was available *ad libitum* during the whole trial period. Feed intake was recorded per group, while weights of animals were recorded individually.

During the experiments, the control groups were fed on basal diets while the treatment groups received the basal diet plus 100 ppm of the phytogenic feed additives AROMEX® ME Plus in trial 1, and 150 ppm FRESTA® *F Plus* in trial 2. The quantity of *Quillaja Saponaria* is the same for both trials. In trial 2 diets were provided as a grower (day 1 - 35) and finisher phase (day 36 - 78). Feed intake has been restricted in trial 1 while feed was available *ad libitum* in trial 2.

Table 1: Calculated feed values for trial 1 and 2.

	AME+	FF+ Grower phase	FF+ Finisher phase
Energy (MJ/kg)	12.8	13.20	13.10
Crude protein (%)	17	17.50	16.00

Ammonia was measured with two portable devices (Dräger, Germany) at an interval of 10 minutes. Temperature and humidity were measured in the barns at animal level, the attic and outside. The means of 10 minutes were recorded in a Mikromec-multisens-data-logger.

Samples for odor measurement were taken 4 times during the trial. Each sample was analyzed by 2 teams composed of 4 subjects each. For quality assurance purposes, the subjects were tested with n-Butanol prior to each measurement, pursuant to DIN EN 13725.

For the evaluation of the odor reducing effect of the additives an olfactometer (Mannebeck, Germany) was used. The odor substance concentration of the exhaust air sample to be measured is determined by thinning it out with synthetic air until the odor threshold is reached. In

addition, an increasing concentration of a constant, odorless stream of air is mixed with an odor-intensive gas flow that is led through a flow meter. This mixture is provided to the test subjects through nose masks for evaluation. In order to determine the personal odor threshold, each subject must make a yes/no decision (it smells/it doesn't smell). The results of the odor substance concentration measurements are provided in OU/m³ (odor units per cubic meter), with all corresponding statistical values.

RESULTS

In both trials no differences in temperature and humidity were observed between the two barns. There were also no significant changes in feed intake and performance detected.

Analysis on ammonia concentrations and odor units showed significant differences between control and treatment groups. In trial 1, results show that the addition of AME+ resulted in an aerial ammonia reduction of 38% for the whole fattening period and the reduction of OU/m³ was 34% (Figure 1). The statistical analyses of trial 2 (FF+) showed a reduction of the ammonia concentration of 32% for the whole period and an average reduction of 32% OU/m^3 (Figure 2). The results of the olfactometric investigations showed a correlation of odor and ammonia concentrations.

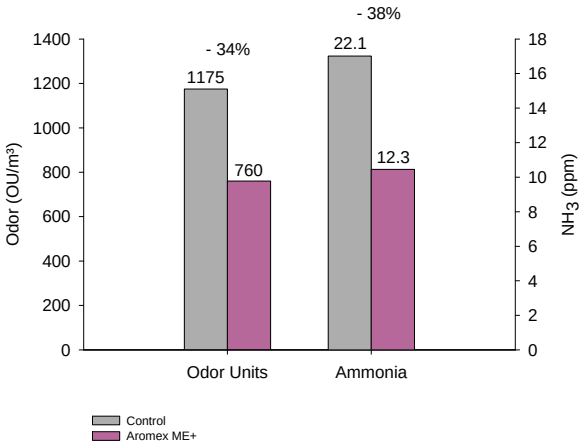

Figure 1: Odor and ammonia concentrations of trial 1 (AME+)

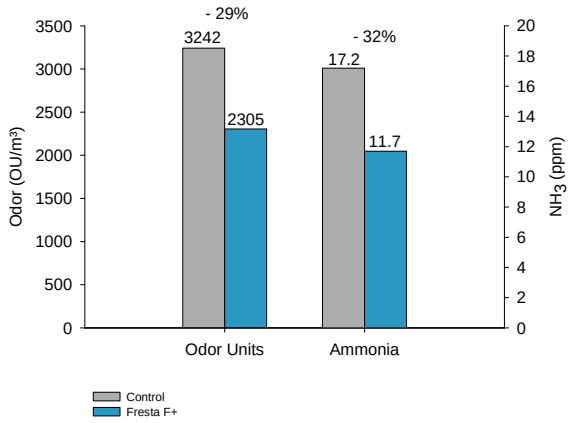

Figure 2: Odor and ammonia concentrations of trial 2 (FF+)

Figure 3 shows the ammonia concentrations for the grower and the finisher phase in trial 2, where lower reductions were shown in the grower phase (25%) than in the finisher phase (36%).

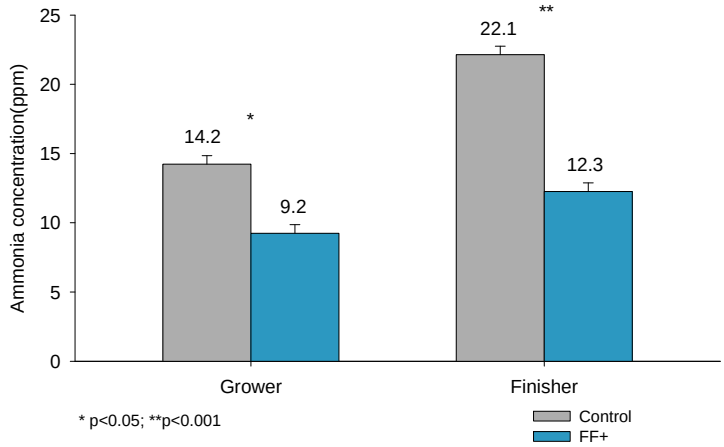

Figure 3: Ammonia concentration in grower and finisher phase of trial 2 (FF+)

DISCUSSION

The results of these trials indicate that the ammonia and odor reduction is due to the inclusion of *Quillaja Saponaria*, which was included at the same quantity per ton of feed in both trials. Same temperature and humidity values, as well as the equal feed intake and performance levels in the trial groups provide comparable conditions for control of feeding strategies on ammonia emissions.

The inhibition of urease is reducing the splitting of urea into ammonia and CO_2 which happens within hours after excretion and leads to an immediate reduction of the

ammonia and odor concentration. The remaining protein in the manure is also fermented by microbes to ammonia, but this is a process which takes days to weeks, which might explain the higher reductions in the finisher phase of trial 2 (Figure 3). The results on ammonia reduction are in line with field trials in piglets (Veit et al., 2010). Although the values for odor units where at different levels in the trials (Figure 1 and 2), a correlation between ammonia concentration and odor units is likely. Reasons for the differences in OU/m^3 might be different feed components or different test persons.

CONCLUSIONS

Both feed additives, AME+ and FF+, showed significant effects on ammonia and odor from growing finishing pigs under identical conditions between control and treatment groups. This indicates that *Quillaja Saponaria* is the active ingredient in these phytogenic feed additives reducing ammonia and odor levels. The reduction of ammonia concentrations at animal level helps to improve health and stress status and thus, contribute to animal welfare. Reduction of OU/m^3 achieved with the tested feed additives is of importance for production sites that have immediate neighbors, and improves working conditions.

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